A multi frequency altimetry snow depth product over the Arctic sea ice

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Since more than 10 years, CryoSat-2 (CS2) has observed and monitored the Arctic Ocean, providing unprecedented spatial and temporal coverage. Satellite altimetry enables to measure sea ice thickness, one essential variable to understand the sea ice dynamics. Numerous sea-ice products developed by the community showed the skills of CS2 to retrieve sea-ice thickness. Nevertheless, several questions remain to better quantify the quality of the measurements. One of them is to better assess the snow depth, a key parameter to obtain the sea ice thickness. In 2018, ICESat-2 mission was launched carrying a LIDAR altimeter. We took advantage of the difference of penetration in the snow layer of laser and Ku-Band altimetry to compute a snow depth product covering the ICESat-2 period. This product is then validated and compared to in situ datasets, reanalysis, models and other snow depth products from satellite missions such as SARAL. Results are quite good concerning the comparison to in situ datasets giving us confidence in the product reliability. In July 2020, the orbit of CryoSat-2 was raised, as part of the CRYO2ICE project, to coincide in space and time to tracks from NASA high resolution altimeter ICESat-2 over the Arctic ocean. This is a unique opportunity to benefit from along-track colocalised data. We present here a methodology to compare ICESat-2 and CryoSat-2 along coincident tracks and compare the resulting snow depth product to gridded products. The lack of in situ measurements is one of the main limitations to analyze the along-track product contribution. Finally we focus on the advantages of combining laser and Ku-band altimetry to lower the uncertainties. The snow depth uncertainties of our product are about 6 cm on average. This ESA-supported study should help prepare the Copernicus CRISTAL mission, which will include a Ka/Ku dual-frequency altimeter for the first time.